

CHAPTER 5

TROUBLESHOOTING

Section I. GENERAL

45. Purpose

Troubleshooting is a systematic isolation of malfunctions and defective components by means of observation of symptoms and performance of tests. Close adherence to the procedures outlined in this chapter will reduce materially the time required to locate and rectify the trouble and restore the equipment to normal operation.

46. Scope

a. The tests and remedies provided herein are governed by the scope of DS and GS maintenance. Table III provides a cross-index of troubleshooting tables and explanatory paragraphs contained in this manual for locating defective components of the launcher and launching-handling rail. The table also lists the associated technical manual (TM) or technical bulletin (TB) containing tests to be used in conjunction with the troubleshooting function.

b. The listed TM or TB gives test hookups, control positions and normal indicator results of the tester equipment for test steps. When an incorrect indication is obtained, the appropriate troubleshooting table should be utilized. The tables list by columns: first, the TM or TB reference; second, the troubleshooting symptom; third, the probable cause; and, in the last column, the corrective action. This last column also gives references to aid in accomplishing the corrective action, either the theory of operation or maintenance instructions in this manual, or the launcher electrical schematics

in TM 9-1440-250-20/2 and the launcher wiring lists in TM 9-1440-250-35/1.

c. In utilizing the listed TM or TB for troubleshooting the launcher equipment, it is assumed that launcher electrical function tester 8523704 and launcher hydraulic power package tester 8529385 used in the tests are in good working order since these procedures do not cover maintenance of the test equipment. Maintenance of the testers is covered in the applicable TM furnished with them.

Table VII. Troubleshooting Index

Unit under test	Pub	Table	Explanation
Launcher base and launcher erecting beam—(continuity and insulation leakage)	TM 9-4935-255-15	none	Par. 51
Launcher electrical and hydraulic erecting systems	TM 9-4935-255-15	VIII	Par. 48
Launching-handling rail — (continuity and insulation leakage)	TM 9-4935-255-15	none	Par. 53
Hydraulic pumping unit	TB 9-1440-252-34/24	IX	Par. 55
Launcher power distribution box—(continuity and insulation leakage)	TM 9-4935-255-15	none	Par. 50

46.1. (USARAL and USAREUR) Scope

a. Paragraph 46 is applicable.

b. For checks of the test station hydraulic pumping unit, refer to TM 9-1440-250-20/1. Wiring lists for this unit are contained in TM 9-1440-250-35/1.

Section II. TROUBLESHOOTING THE LAUNCHER ELECTRICAL AND HYDRAULIC ERECTING SYSTEMS

47. General

Table VIII, paragraph 48, is for use with the launcher functional operation tests con-

tained in TM 9-4935-255-15, in conjunction with launcher electrical function tester 8523704. This combination will give the procedure for

troubleshooting the electrical and hydraulic components of the launcher erecting systems. In addition, the table refers to functional diagrams from TM 9-1440-250-20/2 and to the hydraulic schematics in this book. Where reference is made to the HERCULES launcher elevation functional diagram, be certain to utilize the proper functional circuit, i.e. launcher up, launcher down or combined up or down circuit. The electrical function tester replaces the HERCULES section control-indicator and the HERCULES section simulator group for circuitry and power to the launcher.

48. Procedure

Make the required connections between the

launcher and the launcher electrical function tester and perform the operations as indicated in the launcher functional operation tests in TM 9-4935-255-15. Proceed with the steps indicated by table VIII and progressively check the components described until the cause of the malfunction is found. If the malfunction is due to a defective component which is an authorized replacement by the applicable ORD 8, it should be replaced as described in the applicable maintenance instructions in this manual. When the malfunction is corrected, continue with the troubleshooting procedure. The E and H in the corrective action column refer to electrical- and hydraulic-type steps in the checks as indicated.

Table VIII. Troubleshooting the Launcher Electrical and Hydraulic Erecting Systems

TM step ¹	Trouble symptom	Probable cause	Corrective action
15	The ac motor (fig. 120) of the hydraulic pumping unit fails to start, or the launcher erecting beam (fig. 2) fails to rise.	<p>Poor connection of the two cable assemblies (fig. 4) to the launcher erecting beam.</p> <p>Lack of continuity in the electrical circuits of the defective components in the unit under test.</p> <p>The locking wedges fail to move to the lock position.</p>	<p>Check for the proper connection of P1X and P72A to J1G and J72D.</p> <p>Refer to the HERCULES launcher elevation functional diagram in TM 9-1440-250-20/2. Check in sequence as follows and replace the defective component or cable, or make the adjustment needed.</p> <p>E1. Check the circuit through the launcher control-indicator FIRE-TEST switch.</p> <p>E2. Check the circuit through UP limit switches S18A and S18B N.C. contacts.</p> <p>E3. Check the circuit through rail lock switches S18F and S18G N.C. contacts.</p> <p>E4. Check the circuits through locking wedge relay K2BS.</p> <p>E5. Check the circuit through the coils of wedges lock-unlock solenoid valve L1A.</p> <p>E6. Check the circuit through locking wedge lock and unlock switches S50A and S50C N.O. contacts.</p> <p>E7. Check the circuit through launcher-up relay K2H.</p>

¹ See footnote at end of table.

Table VIII. Troubleshooting the Launcher Electrical and Hydraulic Erecting Systems—Continued

TM step ¹	Trouble symptom	Probable cause	Corrective action
16, 17 and 18	The down-lock mechanism (fig. 39) fails to release the erecting beam hook, and the power and equilibrator cylinders (fig. 3) fail to retract.	Defective components or insufficient hydraulic pressure due to the open line to the hydraulic oil reservoir.	<p>E8. Check the circuit through launcher up-down solenoid valve L1B.</p> <p>E9. Check the circuit through ac motor relay K6A.</p> <p>E10. Check the circuit through ac motor B11A.</p> <p>Refer to figure 8. Check the continuity as follows and replace the defective components or make the adjustment indicated.</p> <p>H1. Check to ensure that the SYSTEM BY-PASS valve (fig. 60) is completely closed.</p> <p>H2. Refer to figure 10. Check the hydraulic down-lock assembly (E, fig. 213).</p> <p>H3. Check to ensure that the EQUILIBRATOR SYSTEM BY-PASS valve (fig. 60) is closed.</p> <p>H4. Check the components of the launcher-up hydraulic system (fig. 8) in order starting with the axial pistons pump (fig. 120), deloader valve assembly group (9, fig. 153), launcher pressure fluid filter (fig. 121), SYSTEM BY-PASS valve (fig. 120), system safety relief valve, missile hydraulic solenoid valve (fig. 121), locking wedge solenoid valve (fig. 120), and the up-down solenoid valve. Replace any defective components as required.</p>
	The launcher erecting beam (fig. 2) fails to lock in the up position, or the ac motor (fig. 120) fails to stop.	The hydraulic pressure to the hydraulic up-lock (fig. 2) prevents the helical compression springs (fig. 217) from pushing the cylinder locking nuts into place and/or the up-lock limit switches (fig. 89) not properly adjusted. Defective relays.	<p>H5. Refer to TM 9-1440-250-20/1 and check the proper adjustment of up-lock limit switches S18A and S18B.</p> <p>E11. Check to ensure that locking wedge relay K2BS and launcher-up relay K2H are deenergized.</p>
	Improper reading on the various phases of the ac motor (fig. 120) check.	Improper setting of the voltage adjustment at the power source, or improper hookup of the leads.	<p>Check for the proper adjustment at the power source.</p> <p>Check the ac motor circuit for the proper wires to the terminals per the 400-cycle ac power distribution functional diagram in TM 9-1440-250-20/1.</p>

¹ See footnote at end of table.

Table VIII. Troubleshooting the Launcher Electrical and Hydraulic Erecting Systems--Continued

TM step ¹	Trouble symptom	Probable cause	Corrective action
22	<p>The hydraulic pumping unit (fig. 3) fails to start or the launcher erecting beam fails to start down.</p> <p>The hydraulic up-lock (fig. 2) fails to retract and the power and equilibrators cylinders (fig. 3) fail to extend.</p> <p>Leaks in the equilibrator system.</p>	<p>Lack of continuity in the electrical circuits, or defective components in the unit under test.</p> <p>Up-lock defective or insufficient hydraulic pressure to operate due to the open line to the hydraulic oil reservoir.</p> <p>Deterioration of pre-formed packings or piston rings.</p>	<p>Refer to TM 9-1440-250-20/2 HERCULES launcher elevation - functional diagram. Check in sequence as follows and replace the defective component or cable.</p> <p>E1. Check the circuit through the launcher control-indicator FIRE-TEST switch.</p> <p>E2. Check the circuit through the N.C. contacts of down-lock limit switch S25A.</p> <p>E3. Check the circuit through launcher-down relay K2G.</p> <p>E4. Check the circuit through hydraulic pump motor relay K6A.</p> <p>E5. Check the circuit through hydraulic pump motor B11A.</p> <p>E6. Check the circuit through launcher up-down solenoid valve L1B.</p> <p>Refer to figure 10. Check the flow as follows and replace any defective components or make adjustments as indicated.</p> <p>H1. Check to ensure that the SYSTEM BY-PASS valve (fig. 60) is closed.</p> <p>H2. Check the hydraulic pumping unit components starting with the axial pistons pump (fig. 120), deloader valve assembly group (9, fig. 153), launcher pressure fluid filter (fig. 121), SYSTEM BY-PASS valve (fig. 120), system safety relief valve, missile hydraulic solenoid valve (fig. 121), locking wedge solenoid valve (fig. 120), and the up-down solenoid valve. Replace any defective component as required.</p> <p>H3. Check the equilibrator safety relief valve assembly (fig. 159).</p> <p>H3.1. Close the equilibrator by-pass valve.</p> <p>H3.2. Cycle the launcher erecting beam, pressurizing the equilibrator system.</p> <p>H3.3. Depressurize the hydraulic oil reservoir.</p> <p>H3.4. Remove the B nut from the gooseneck fitting at the end of both equilibrator cylinders and cap them off.</p> <p>H3.5. Remove the rear bleed plug from both equilibrator cylinders. In the event hydraulic oil flows from either opening, that cylinder is defective.</p>

¹ See footnote at end of table.

Table VIII. Troubleshooting the Launcher Electrical and Hydraulic Erecting Systems—Continued

TM step ¹	Trouble symptom	Probable cause	Corrective action
	The locking wedges fail to extend.	Defective locking wedge solenoid valve (fig. 120), or locking wedge solenoid circuit not closed by down-lock limit switch S25A.	<p>H3.6. Replace any defective component as required.</p> <p>H4. Check the locking wedge solenoid valve.</p> <p>H5. Check the locking wedge hydraulic cylinder group (fig. 110). Refer to TM 9-1440-250-20/2 HERCULES launcher elevation—functional diagram for making the following checks.</p> <p>E7. Check the circuit through the N.O. contacts of down-lock limit switch S25A.</p> <p>E8. Refer to TM 9-1440-250-20/1 and check the proper adjustment of switch S25A.</p> <p>E9. Check the current through wedge unlock relay K2BT.</p> <p>E10. Check the circuit through the coils of wedges lock-unlock solenoid valve L1A.</p> <p>E11. Check the circuit through front and rear locking wedge unlock limit switches S50B and S50D.</p> <p>E12. Check S50B and S50D for the proper adjustment.</p> <p>E13. Check to ensure that wedge unlock relay K2BT is deenergized.</p> <p>E14. Check to ensure that launcher-down relay K2G is deenergized.</p> <p>E15. Check to ensure that launcher-up relay K2H is deenergized.</p> <p>E16. Check to ensure that hydraulic pump motor relay K6A is deenergized.</p>
	The ac motor (fig. 120) and the axial pistons pump fail to stop.	The ground is not removed from pump motor relay K6A or the other relays are defective.	

¹ Step entries refer to the launcher functional operation acceptance test in TM 9-4935-255-15.

Section III. TROUBLESHOOTING THE LAUNCHER ELECTRICAL INSTALLATION

49. General

Troubleshooting the launcher electrical installation is accomplished through the use of launcher electrical function tester 8523704, and the circuit continuity and insulation leakage tests contained in TM 9-4935-255-15. The tests are utilized to identify the fault. Then, by using the appropriate schematic in TM 9-1440-250-20/2 and associated wiring list in TM 9-1440-250-35/1, the identified circuit

can be traced for continuity or insulation leakage from point to point.

50. Launcher Power Distribution Box

Circuit continuity and high-potential insulation leakage tests of the launcher power distribution box are contained in TM 9-4935-255-15. Make the required connections and perform the operations as prescribed in TM 9-4935-255-15. When a fault is discovered,

refer to the applicable READOUTS table contained in the test procedure to identify the unit-under-test (UUT) connector pin or socket involved in the faulty circuit. When the pin or socket is identified, refer to the applicable wiring list table in TM 9-1440-250-35/1 to identify the opposite-end connection. This procedure enables the operator to trace the specific circuit on the equipment and locate the malfunction.

51. Launcher Base and Launcher Erecting Beam

■ Circuit continuity and high-potential insula-

tion leakage tests of the launcher base and launcher erecting beam are contained in TM 9-4935-255-15. Make the required connections and perform the operations as prescribed in TM 9-4935-255-15. When a fault is discovered, refer to the applicable READOUTS table contained in the test procedure to identify the UUT connector pin or socket involved in the faulty circuit. When the pin or socket is identified, refer to the applicable wiring list tables in TM 9-1440-250-35/1 to check the circuit at the other end as indicated in the test procedure.

Section IV. TROUBLESHOOTING THE LAUNCHING—HANDLING RAIL

52. General

Troubleshooting the electrical installation of the launching-handling rail is accomplished through the use of launcher electrical function tester 8523704. TM 9-4935-255-15, and the wiring list table for the launching-handling rail from TM 9-1440-250-35/1. The circuit continuity and insulation leakage tests in TM 9-4935-255-15 are utilized to identify the fault. Then, by using the referenced wiring list table, the identified circuit can be traced for continuity or insulation leakage from point to point.

53. Procedure

Make the required connections from the tester

to the launching-handling rail as prescribed in TM 9-4935-255-15. Proceed with the continuity and insulation leakage tests. When a fault is indicated refer from the READOUT indicator on the tester to the proper table in the test procedure for the faulty circuit reference. The "Test set in" column in the table refers to the particular jack and pin from which to start the circuit check. On the launching-handling rail wiring list table in TM 9-1440-250-35/1 follow the circuit through to the other end as indicated in the test procedure. This enables the operator to trace the circuit on the equipment and locate the malfunction. Before performing any high-voltage leakage tests, all faulty continuity circuits must be repaired.

Section V. TROUBLESHOOTING THE HYDRAULIC PUMPING UNIT

54. General

Table IX, paragraph 55, is for use with TB 9-1440-252-34/24, dated 14 September 1961, in conjunction with launcher hydraulic power package tester 8529385 for troubleshooting the components of the launcher hydraulic power unit assembly (hydraulic pumping unit). The table also makes reference to hydraulic schematic diagrams in this manual for system tracing purposes. The tester replaces all hydraulic and electrical functions performed by the launcher.

55. Procedure

Make the required connections between the power package tester and the pumping unit and perform the operations as indicated in TB 9-1440-252-34/24. Proceed with the steps indicated by Table IX and progressively check the components described until the cause of the malfunction is found. If the malfunction is due to a defective component which is an authorized replacement by the applicable ORD 8, it should be replaced in accordance with the applicable maintenance instructions in this manual. When the malfunction is corrected, continue with the troubleshooting procedure.

Table IX. Troubleshooting the Hydraulic Pumping Unit

TB step	Trouble symptom	Probable cause	Corrective action
3b	The SURGE ACCUMULATOR PRESSURE gage (fig. 59) fails to show 1800 to 2200 psi.	The hydraulic surge accumulator (fig. 121) not precharged. Leaks in the system.	Pressurize the surge accumulator to 2000 psi with dry air or nitrogen. Check the precharge air pressure (fig. 11) in the system to the hydraulic surge accumulator for leaks. Check the valve assembly.
		Defective SURGE ACCUMULATOR AIR FILLER 2000 psi MAX valve assembly (fig. 149).	
		Defective SURGE ACCUMULATOR PRESSURE gage assembly (fig. 148).	Check the gage assembly.
		Defective tube assembly or fittings.	Check the tube assembly (16, fig. 152).
4a(1)f	The PUMP HYDRAULIC PRESSURE gage (fig. 59) fails to reach 3150 psi.	The precharge SYSTEM BY-PASS valve is not closed.	Check that the SYSTEM BY-PASS valve (fig. 60) is closed.
		Leaks in the system.	Check the hydraulic system for leaks (fig. 8).
		Defective components in the launcher-up hydraulic system.	Check the missile hydraulic solenoid valve (fig. 121).
		The reloader valve assembly group (9, fig. 153), not closing at 800 psi.	Check the system safety relief valve (fig. 120).
		Restriction in the hydraulic system.	Check the axial pistons pump. Check the deloader valve assembly.
	The PUMP HYDRAULIC PRESSURE gage (fig. 59) indicates above 3350 psi.		Check the launcher pressure fluid filter (fig. 121) for a defective element.
4a(1)h	The SURGE ACCUMULATOR PRESSURE (fig. 59) drops below 500 psi tolerance.	The SYSTEM BY-PASS valve is not closed. Leaks in the system.	Check the system for crimps. Check that the SYSTEM BY-PASS valve (fig. 60) is closed. Check the hydraulic system for leaks (fig. 8).
			Check the check valve assembly (11, fig. 153) in the pump pressure line.
			Check the system safety relief valve (fig. 120).
			Check the up-down solenoid valve (fig. 120), the locking wedge solenoid valve (fig. 120), and the missile hydraulic solenoid valve (fig. 121) for leaks in the neutral position.
4a(1)k	FLOW METER NO. 2 fails to show 9.75 gpm.	Defective component in the launcher-up hydraulic system (fig. 8), or restriction in the line.	Check the launcher pressure fluid filter (fig. 121) for a defective element. Check the deloader valve assembly (9, fig. 153).
			Check the SYSTEM BY-PASS valve (figs. 60 and 146).

Table IX. Troubleshooting the Hydraulic Pumping Unit—Continued

TB step	Trouble symptom	Probable cause	Corrective action
4a(1)m	<p>FLOW METER NO. 1 fails to show 0.4 \pm 0.1 gpm for one minute.</p> <p>The HYD PRESSURE gage fails to remain constant for one minute within \pm 50 psi variation.</p>	Defective component in the launcher-up hydraulic system (fig. 8).	<p>Check the system safety relief valve (fig. 120).</p> <p>Check the up-down solenoid valve for an incomplete opening of the valve.</p> <p>Check for the fully opened missile hydraulic solenoid valve (fig. 121) or the locking wedge solenoid valve (fig. 120).</p> <p>Check, or replace the axial pistons pump.</p> <p>Check for a crimp in the line at all items in 4a(1)k above.</p> <p>Check the launcher pressure fluid filter (fig. 121) for a defective element.</p>
4a(1)s	<p>FLOW METER NO. 2 fails to show 5 gpm flow.</p>	Defective component in the launcher-down hydraulic system (fig. 10), or a restriction in the line.	<p>Check the axial pistons pump for malfunction.</p> <p>Check the launcher pressure fluid filter (fig. 121) for a defective element.</p> <p>Check the axial pistons pump (fig. 120) for malfunction.</p> <p>Check the deloader valve assembly group (9, fig. 153).</p> <p>Check the up-down solenoid valve (fig. 120) for an incomplete opening of the valve.</p> <p>Check the SYSTEM BY-PASS valve (figs. 60 and 146).</p> <p>Check for the fully opened missile hydraulic solenoid valve (fig. 121) or the locking wedge solenoid valve (fig. 120).</p> <p>Check the system safety relief valve (fig. 120).</p>
4a(1)aa	The system safety relief valve (fig. 120) cracks above 3600 psi or below 3400 psi as indicated on the HYD PRESSURE gage.	Defective or improperly adjusted system safety relief valve (fig. 120).	<p>Check and adjust the system safety relief valve as prescribed in TM 9-1440-250-20/1.</p> <p>Check the safety relief valve.</p>
4b(1)e	The PUMP HYDRAULIC PRESSURE gage (fig. 59) fails to show 1800 to 2200 psi.	<p>The system is not closed.</p> <p>Defective component in the missile hydraulic system.</p>	<p>Check that the SYSTEM BY-PASS valve (fig. 69) is closed.</p> <p>Check the hydraulic system for leaks (fig. 34).</p>

Table IX. Troubleshooting the Hydraulic Pumping Unit—Continued

TB step	Trouble symptom	Probable cause	Corrective action
4b(1)f	The PUMP HYDRAULIC PRESSURE gage reads above 2050 psi	Restriction in the system.	<p>Check the missile hydraulic solenoid valve (fig. 121).</p> <p>Check the pressure reducer valve.</p> <p>Check the deloader valve assembly group (9, fig. 153) for closing at 800 psi.</p> <p>Check the launcher pressure fluid filter (fig. 121) and the missile hydraulic pressure fluid filter for clogging or a defective element.</p> <p>Check the system safety relief valve (fig. 120).</p> <p>Check the axial pistons pump.</p> <p>Check the launcher pressure fluid filter (fig. 121) and the missile hydraulic pressure fluid filter for damaged elements.</p> <p>Check the pressure reducer valve for proper setting. Adjust the reducer valve to obtain a reading of 2000 \pm 50 psi on the PUMP HYDRAULIC PRESSURE gage (fig. 59).</p> <p>Check the system for crimps.</p>
	FLOW METER NO. 2 fails to show 5 gpm flow	Defective components in the missile hydraulic system (fig. 34).	<p>Check the missile hydraulic solenoid valve (fig. 121).</p> <p>Check the launcher pressure fluid filter and the missile hydraulic pressure fluid filter for clogging or a defective element.</p> <p>Check the pressure reducer valve (fig. 121). Check the SYSTEM BY-PASS valve (figs. 60 and 146).</p> <p>Check the system safety relief valve (fig. 120).</p> <p>Check the deloader valve assembly group (9, fig. 153).</p> <p>Check for leaks on the locking wedge solenoid valve (fig. 120) and the up-down solenoid valve.</p> <p>Check the axial pistons pump for malfunction.</p>
4c(1)f or h	FLOW METER NO. 2 fails to show 5 gpm flow.	Defective component in the hydraulic system (figs. 8 and 10).	<p>Check the missile hydraulic solenoid valve (fig. 121) for porting to the hydraulic oil reservoir (fig. 2).</p> <p>Check for the locking wedge solenoid valve (fig. 120) not opening properly.</p> <p>Check the launcher pressure fluid filter for clogging or a defective element.</p> <p>Check the SYSTEM BY-PASS valve (figs. 60 and 146).</p> <p>Check the system safety relief valve (fig. 120).</p> <p>Check the deloader valve assembly group (9, fig. 153).</p> <p>Check for leaks on the up-down solenoid valve (fig. 120).</p> <p>Check the axial pistons pump for malfunction.</p>

